

## CLAIMS

1. An impact driver for driving elongate objects into a body, said impact driver comprising
  - a. a chassis
  - 5 b. a ram supported by said chassis in a manner allowing rectilinear movement of said ram relative to said chassis between two limits,
  - c. a linear induction motor having a stator mounted to said chassis and positioned to operatively interact with a linear induction motor reaction means being of a conductive metal material, said reaction  
10 means carried by said ram in a manner to allow the ram to oscillate between said two limits by the stator of said linear induction motor, a first limit being a retracted position and a second limit being an impact position to which the ram is accelerated from said retracted condition by said stator and at which said ram imparts an impact  
15 force on said elongate object in the elongate direction thereof.
2. An impact driver as claimed in claim 1 wherein said ram includes a means defining an impact head and an elongate ram support structure, said ram support structure having a first and second distal ends, said impact head provided at a first distal end of said ram support structure, said reaction means being of an  
20 elongate nature and engaged to and extending in the elongate direction of said ram support structure between said first and second distal ends thereof.
3. An impact driver as claimed in claim 1 wherein said ram includes a means defining an impact head and said reaction means, said reaction means being of an elongate nature and having a first and second distal end, said impact head  
25 provided at a first distal end.
4. An impact driver as claimed any one of claims 1 to 3 wherein said impact head is of a robust and substantially solid material.
5. An impact driver as claimed any one of claims 1 to 4 wherein said reaction means is an elongate structure.

6. An impact driver as claimed in any one of claims 1 to 5 wherein said reaction means comprises at least one plate of a conductive metal material.
7. An impact driver as claimed any one of claims 1 to 6 wherein said ram bears with said chassis in a manner to allow rectilinear movement of said ram relative to said chassis.
8. An impact driver as claimed any one of claims 1 to 7 wherein said chassis provides ram bearing means which locate said ram with said chassis.
9. An impact driver as claimed in claim 8 wherein said ram bearing means is located within a casing of said chassis, said ram also at least in part provided and retained by said bearing means within said casing of said chassis.
10. An impact driver as claimed in claims 8 or 9 wherein said stator of said linear induction motor is positioned within the casing of said chassis.
11. An impact driver as claimed in any one of claims 1 to 10 wherein said chassis includes a casing defining an elongate chamber within which at least part of said ram is able to move in the elongate direction.
12. An impact driver as claimed in any one of claims 1 to 11 wherein the relative position of said ram at least when in one position with respect to said chassis is able to be sensed by an electronic sensor.
13. An impact driver as claimed in claim 12 wherein a said electronic sensor is a limit sensor detecting the reaching of the ram to or proximate to its retracted position.
14. An impact driver as claimed in claims 12 or 13 wherein a said electronic sensor is in communication with control means of the linear induction motor to trigger the control means to accelerate the hammer from the retracted position to the impact position.
15. An impact driver as claimed in any one of claims 1 to 14 wherein said stator is controlled to accelerate the ram from the retracted position to the impact position at a rate greater than from the impact position to the retracted position.
16. An impact driver as claimed in any one of claims 1 to 15 wherein a anvil assembly is positioned relative to said chassis to hold an anvil in alignment to the

rectilinear direction of movement of said ram to be interposed between the head of said elongate object and said impact head for the purpose of providing a cushioning to the impact force of said ram applied to said elongate object.

17. An impact driver as claimed in claim 16 wherein said anvil assembly is in a translatable engagement with said chassis.
18. An impact driver as claimed in claims 16 or 17 wherein said anvil assembly presents said anvil at a location remote from said chassis.
19. An impact driver as claimed in claim any one of claims 1 to 18 wherein said chassis is mounted to a support structure.
20. An impact driver as claimed in claim any one of claims 16 to 18 wherein said chassis is mounted to a support structure and said anvil assembly is in a translatable engagement with said support structure to permit its movement relative thereto and parallel to the rectilinear direction of movement.
21. An impact driver as claimed in claim any one of claims 1 to 18 wherein said chassis is mounted to a support structure.
22. An impact driver as claimed in claim 21 wherein said support structure includes a means to mount to a vehicle.
23. An impact driver as claimed in claim 22 wherein said means to mount allows said support structure to rotate relative to said vehicle.
24. An impact driver as claimed in claims 22 or 23 wherein said means to mount allows said support structure to translate relative to said vehicle.
25. An impact driver as claimed in any one of claims 1 to 24 wherein said chassis is mounted to a support device selected from one of a vehicle, a vessel and a derrick.
26. An impact driver as claimed in claim 25 wherein said chassis is connected to the support device by an articulatable connection means.
27. An impact driver as claimed in any one of claims 1 to 26 wherein the impact driver is a pile driver.
28. An impact driver as claimed in any one of claims 1 to 27 wherein the overall operational height of the impact driver remains less than 3m.

29. An impact driver as claimed in any one of claims 1 to 28 wherein the overall operational height of the impact driver remains less than 2.5m.
30. An impact driver as claimed in any one of claims 1 to 29 wherein the overall operational height of the impact driver remains less than 2.0m.
- 5 31. An impact driver as claimed in any one of claims 1 to 29 wherein the overall operational height of the impact driver remains less than 1.5m.
32. A double acting driver for driving elongate objects into a body said driver including a ram which relies on power from a linear induction motor stator and gravity to accelerate the ram during its compression stroke.
- 10 33. A driver for driving elongate objects into a body said driver including a ram which relies on power from a linear induction motor stator to accelerate the ram during its compression stroke.
34. A method of driving elongate objects into a body utilising the impact driver as claimed in any one or more of claims 1 to 33.
- 15 35. A method of pile driving utilising the impact driver as claimed in any one or more of claims 1 to 33.
36. A method of driving elongate objects into a body utilising gravity to accelerate an impact ram to impact the head of an elongate and a linear induction motor stator interacting with a reactor plate of said ram, to enhance acceleration
- 20 of the ram beyond  $9.81 \text{ m/s}^2$  during its compression stroke.
37. A driver for driving elongate objects into a body said driver including a ram which is accelerated by assistance of gravity and by a linear induction motor stator interacting with a reactor plate of said ram to enhance acceleration of the ram beyond  $9.81 \text{ m/s}^2$  during its compression stroke.
- 25 38. An elongate object extraction device for extracting elongate objects from body said device including a ram which relies on power from a linear induction motor stator to accelerate the ram during its extracting stroke, said ram including means to engage with said elongate object to subject it to a force from the ram during its extraction stroke.

39. An elongate object extraction device for extracting elongate objects from a body, said device comprising

- a. a chassis
- b. a ram supported by said chassis in a manner allowing rectilinear  
5 movement of said hammer relative to said chassis between two limits,
- c. a linear induction motor having a stator mounted to said chassis and positioned to operatively interact with a linear induction motor reaction means being of a conductive metal material, said reaction  
10 means carried by said ram in a manner to allow the ram to oscillate between said two limits by the stator of said linear induction motor, a first limit being an elongate object proximate more position and a second limit tending towards an extraction position to which the ram is accelerated from said proximate more position by said stator  
15 and at which said elongate object is or tends towards being extracted from said object.